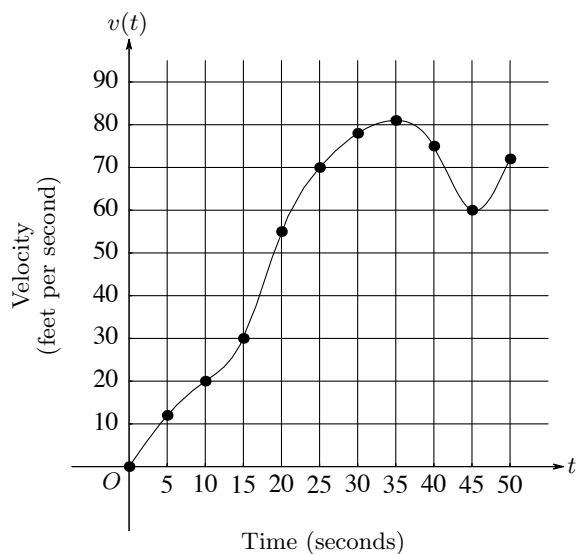


1998 AP Calculus AB Free-Response Questions

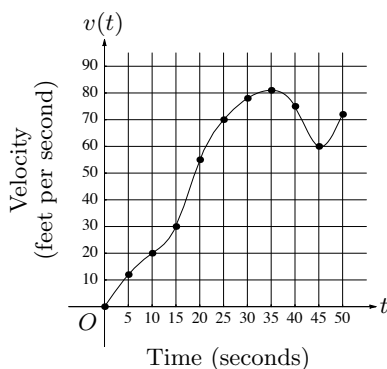


t (seconds)	$v(t)$ (feet per second)
0	0
5	12
10	20
15	30
20	55
25	70
30	78
35	81
40	75
45	60
50	72

3. The graph of the velocity $v(t)$, in ft/sec, of a car traveling on a straight road, for $0 \leq t \leq 50$, is shown above. A table of values for $v(t)$, at 5 second intervals of time t , is shown to the right of the graph.
- During what intervals of time is the acceleration of the car positive? Give a reason for your answer.
 - Find the average acceleration of the car, in ft/sec², over the interval $0 \leq t \leq 50$.
 - Find one approximation for the acceleration of the car, in ft/sec², at $t = 40$. Show the computations you used to arrive at your answer.
 - Approximate $\int_0^{50} v(t) dt$ with a Riemann sum, using the midpoints of five subintervals of equal length. Using correct units, explain the meaning of this integral.

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1998 Calculus AB Scoring Guidelines



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3. The graph of the velocity $v(t)$, in ft/sec, of a car traveling on a straight road, for $0 \leq t \leq 50$, is shown above. A table of values for $v(t)$, at 5 second intervals of time t , is shown to the right of the graph.
- During what intervals of time is the acceleration of the car positive? Give a reason for your answer.
 - Find the average acceleration of the car, in ft/sec², over the interval $0 \leq t \leq 50$.
 - Find one approximation for the acceleration of the car, in ft/sec², at $t = 40$. Show the computations you used to arrive at your answer.
 - Approximate $\int_0^{50} v(t) dt$ with a Riemann sum, using the midpoints of five subintervals of equal length. Using correct units, explain the meaning of this integral.

- (a) Acceleration is positive on $(0, 35)$ and $(45, 50)$ because the velocity $v(t)$ is increasing on $[0, 35]$ and $[45, 50]$

$$3 \left\{ \begin{array}{l} 1: (0, 35) \\ 1: (45, 50) \\ 1: \text{reason} \end{array} \right.$$

Note: ignore inclusion of endpoints

- (b) Avg. Acc. = $\frac{v(50) - v(0)}{50 - 0} = \frac{72 - 0}{50} = \frac{72}{50}$
or 1.44 ft/sec²

1: answer

- (c) Difference quotient; e.g.

$$\frac{v(45) - v(40)}{5} = \frac{60 - 75}{5} = -3 \text{ ft/sec}^2 \text{ or}$$

$$\frac{v(40) - v(35)}{5} = \frac{75 - 81}{5} = -\frac{6}{5} \text{ ft/sec}^2 \text{ or}$$

$$\frac{v(45) - v(35)}{10} = \frac{60 - 81}{10} = -\frac{21}{10} \text{ ft/sec}^2$$

–or–

Slope of tangent line, e.g.

$$\text{through } (35, 90) \text{ and } (40, 75): \frac{90 - 75}{35 - 40} = -3 \text{ ft/sec}^2$$

$$2 \left\{ \begin{array}{l} 1: \text{method} \\ 1: \text{answer} \end{array} \right.$$

Note: 0/2 if first point not earned

- (d) $\int_0^{50} v(t) dt$
 $\approx 10[v(5) + v(15) + v(25) + v(35) + v(45)]$
 $= 10(12 + 30 + 70 + 81 + 60)$
 $= 2530 \text{ feet}$

This integral is the total distance traveled in feet over the time 0 to 50 seconds.

$$3 \left\{ \begin{array}{l} 1: \text{midpoint Riemann sum} \\ 1: \text{answer} \\ 1: \text{meaning of integral} \end{array} \right.$$